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MANAGEMENT OF NATURAL RESOURCES AND THE ENVIRONMENT IN ZIMBABWE: THE CASE OF GOLD

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ABBREVIATIONS

CBA	Cost Benefit Analysis
CoM	Chamber of Mines (Zimbabwe)
CSO	Central Statistical Office (Zimbabwe)
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIU	Economist Intelligence Unit
EPP	Export Promotion Programme
ESAP	Economic Structural Adjustment Programme
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation (Gross Investment)
Hg	Mercury
HSCB	Hazardous Substances Control Board
IMR	Institute of Mining Research (Zimbabwe)
MoM	Ministry of Mines (Zimbabwe)
NRB	Natural Resources Board
SADC	Southern African Development Community
SFYNDP	Second Five Year National Development Plan (Zimbabwe)

SUMMARY

1. The history of mining, in particular gold mining, and that of Zimbabwe are inseparable, for it was the lure of a second *'Witwatersrand'* that attracted Cecil Rhodes's British South Africa Company into Zimbabwe. Today Zimbabwe mines a wide variety of minerals, the latest addition being diamond which is mined by Auridium Resources of Australia. The total value of mineral production (at mine value) in 1992 was 2,418 million Zimbabwe dollars, an increase of 31 per cent over 1991 production. Mineral exports in 1991 (including exports of processed products such as ferrochrome, pig iron, steel, cement, ceramics and coke) totalled 3,024 million Zimbabwe dollars representing 37 per cent of total exports and averaged 41 per cent of total exports for the period 1979-1991. This makes the mining industry in Zimbabwe an important contributor to overall economic growth and development. Mining also plays an important role in employment generation, provision of inputs to manufacturing and generation of export revenues.

2. Although dominated by large multinationals, the Zimbabwean mining sector has numerous small scale operators who make significant contributions to total mineral output. The major multinationals operating in this country include Anglo American Corporation of South Africa, Cluff Resources, RTZ, Lonrho, Turner Newall, Falconbridge and Union Carbide. In addition to private mining operations, both local and foreign, the government operates mines through the Zimbabwe Mining Development Corporation which is involved mainly in base and precious metals mining. It is also responsible for the chromite mining co-operatives on the Great Dyke.

3. Though Zimbabwe mines over forty minerals, gold is singularly the country's most important mineral. It accounts for about 31 per cent of total mining employment, 34 per cent of total mineral exports and 42 per cent of the value of total mineral production (at mine value). Gold has remained the country's major export earner since 1979 when it overtook asbestos (except for a brief period in 1988 when a spectacular boom in ferrochrome prices catapulted ferro-alloys to the top). As is the case with the rest of the mining sector in Zimbabwe, gold mining is dominated by large mining companies. These contribute over 70 per cent to total gold output with the remaining 30 per cent coming from numerous formal and informal medium- to small-scale mines scattered around the country. However, added to this is a significant proportion of gold that is lost to the parallel market, especially output from illegal alluvial gold panners. For a number of reasons the panners prefer to sell their output outside the official channels. The parallel market for gold flourishes mainly because of the panners' need for immediate cash as compared to the delays experienced in getting payments from the Reserve Bank of Zimbabwe (the sole buyer of gold in Zimbabwe) and the lack of legal buying offices in close proximity to panning areas, despite the Reserve Bank paying almost twice as much per gram (75 Zimbabwe dollars) as the other dealers (35 to 45 Zimbabwe dollars). The critical factor seems to be the panners' need for ready cash and they will sell to anyone who is able to offer this, since panning is their only source of cash income. The panning industry is prevalent along the country's major rivers especially the Mazowe, Runde, Insiza and Umzingwane rivers. Panning has also been reported on some mine dumps. The actual number of panners is unknown but it is estimated that up to 100,000[1] panners exist in Zimbabwe, at one time or another.

4. The gold mining and processing industry in Zimbabwe is complex as it encompasses different types of operations and situations, given the wide spectrum of operations from the artisanal gold miners and alluvial panners to the large-scale, highly mechanized gold mines. Given the structure of the mining industry, it is important to separate the different activities of the different groups of gold miners which impinge upon the environment.

5. From a general point of view, the major environmental problems caused by gold mining and processing include air pollution (dust), noise pollution, soil and surface and subsurface water contamination by cyanide, mercury, lead and arsenic. In the case of mercury, concentrations of over 2 ppm and 200 ppm, respectively, have been found in water and soil samples from some mining locations. Mercury is used especially by alluvial gold panners, and it finds its way into the river systems and the atmosphere since there is no process in use for its recovery. Use of cyanide for gold recovery is also prevalent in Zimbabwe,

especially at medium and large operations. It is the disposal of tailings which creates problems for the environment as untreated effluent finds its way into groundwater and even surface water. Arsenic emissions are mainly from the state-owned Roasting Plant in Kwekwe which was set up to treat refractory ores. Added to these effects on the natural ecosystem is damage to fauna and flora from disposal of mine water and tailings. This culminates in the dissipation of vegetation cover and loss of the genetic diversity of plants as well as disturbance of wildlife habitats. In the case of the alluvial gold miners, it is estimated that over 50 per cent of cyanide and mercury being used is lost into the atmosphere and the water system, causing substantial contamination.

6. In addition to contamination by chemicals used in gold processing, there are other results which change the landscape of the area of operations in a negative sense. Associated with alluvial panning is land disturbance. People build temporary shelters. There is deforestation through timber felling for fuel and construction purposes, and land subsidence (in particular close to river banks). Further, there is siltation of the rivers from erosion of panned-out river banks and beds, and unsightly large volumes of solid waste littered in the vicinity of the areas of operations. Sometimes gold panners work on abandoned mine shafts and create deep channels during panning resulting in the creation of unstable openings prone to collapse.

7. Most of the damage to the environment caused by small-scale miners is due to lack of knowledge but part is due to neglect. Since most panners are driven by tough economic needs, it is very difficult to convince them that it is essential to protect the environment for sustainability. Only when alternative means of livelihood are provided could they be environmentally conscious or at least use environmentally benign technology.

8. In the formal mines, environmental degradation is mainly due to neglect and exploitation of the limitations and weaknesses of current legislation and regulations. Some regulations exist for environmental management but, for various reasons, not least the shortage of trained manpower, they are not enforced and some companies deliberately ignore them. Some companies also feel that environmental compliance costs increase production costs and thus make some projects uneconomic. This calls for an activist policy to make sure that sound environmental management does not affect project viability.

9. The principal agent responsible for environmental management and sustainable development in Zimbabwe is the Ministry of Natural Resources and Tourism through the Natural Resources Board (NRB), the principal custodian of environmental matters in Zimbabwe. For the minerals industry, a mineral resources committee exists as an arm of the NRB. Statutory instruments which work in conjunction with the NRB are: the Mines and Minerals Act, the Water Act, Hazardous Substances Act, Atmospheric Pollution Prevention Act, Stream Bank Prevention Regulations, Mining and Safety Regulations, and Mining (Alluvial Gold) Public Streams Regulations. In addition, the Government's intention to manage the environment prudently is espoused in the Second Five Year National Development Plan (1991-1995) which makes sustainable development and sound environmental management topical issues. Through the Ministry of the Environment, the Government is in the process of formulating environmental impact assessment (EIA) guidelines. These guidelines are in line with Agenda 21 of the United Nation's environmental policy and are intended to make it imperative for EIA to be done before project approval.

10. Even though environmental regulations have existed in some form for the past 30 years, flouting of these regulations continues unabated. Constraints to effective environmental compliance in Zimbabwe include:

- Lack of explicit, well-coordinated and specific regulations,

- Lack of adequately trained manpower: there is only one mining commissioner in each mining district to supervise on average 300 mines; no training on environmental matters is offered in Zimbabwean educational institutions,

- Poor mining practices, e.g. inappropriate use of mercury,

- Lack of finance to run environmental departments, and

- Perceived high costs of production associated with environmental protection by some mining companies.

11. Compounding environmental problems are contradictions between promotion of economic growth and environmental management. For example, given the existing investment gap, Zimbabwe has joined other developing countries in rewriting its investment regulations to satisfy the requirements of foreign investors. However, to ensure competitiveness, the focus on environmental management has been overshadowed by the need for more investment. It is therefore not surprising that the current Zimbabwe Investment Brochure makes only a passing mention of the need to practice prudent environmental management in the exploitation of resources. Strict requirements for EIA before project commencement are seen as counter-productive in jeopardizing competitiveness and thus it is left to the individual mining company to undertake any such studies.

12. Countries in Sub-Saharan Africa have been facing declining terms of trade for a long time and therefore emphasis has been on further mineral processing to increase value-added. This has led, in the case of gold in Zimbabwe, to the opening up of the country's only gold refinery in 1989. What is not quantified however, is environmental contamination by fumes resulting from the gold refining. Prior to that, the Government had introduced a gold stabilization scheme in 1984 designed to cushion producers against swings in the international gold price and also ensure increased revenues for the Government.

13. The immediate result of this policy was a gold rush, as the floor price made gold mining very attractive. Many small scale mines came on stream at that time, which led to massive environmental problems, especially destruction of vegetation and creation of unprotected pits and large mounds of waste rock. Given the shortage of foreign exchange needed for the import of mining machinery, the Government, with assistance from European banks, introduced a mineral export promotion programme under which all exporting mines had access to a special fund to enable them to procure the required equipment. The principal users of this special fund were gold mines. This led to increased gold mining activities and increased revenues for government through corporate taxes and also increased environmental damage. The major point to note is that the shortage of foreign exchange in itself was not only a constraint to production but also to investment and adoption of "green" technology. In addition, in a move to encourage further processing, since the early 1970s mining companies have been exempted from paying royalties (although there is a provision for paying it in current legislation) in an effort to encourage further downstream mineral processing.

14. To date only four EIAs have been carried out in the country. Even these EIAs have been done with little or no participation from the Government. Because of resource constraints, the preparation of EIAs has remained at the discretion of the individual company.

15. To improve environmental performance and compliance in Zimbabwe, there is a need to establish cooperation between mining companies, the Government and the general public. In the first instance, the government should, in consultation with the mining companies, establish legislation which strictly controls mining-related environmental degradation by giving more power to the Natural Resources Board to police compliance. Once such regulations are in place, efforts at policing them should be stepped up, first by educating officers within the NRB and the Ministry of Mines on environmental issues, then following up with visits to mines. Training on environmental issues should also be extended to personnel from mining companies. A dialogue should be opened between mining companies and the Government.

16. Since legislation has proved difficult to enforce, the Government may want to try market based incentives (MBIs) as alternatives or complements to existing legislation. Such incentives would include instruments such as environmental bonds which companies would post before commencing operations, pollution bonds and tax relief, establishment of rehabilitation funds from revenues generated during mine-life and environmental competitions. Participation in environmental competitions should be compulsory for all mines and enforced by stiff penalties

for non-participation.

17. If environmental management programmes are to be successful in Zimbabwe, mining companies should take part in the development of environmental guidelines and their implementation. Companies should have internal environmental policies and they should carry out environmental auditing of their own operations. The need for EIAs before project commencement is well understood: most companies seem to be aware of the need to protect the environment. Mining companies cannot afford to be passive participants in this regard and any approach that results in government acting on its own, might result in policies which are not necessarily in the best interest of the mining companies. Initiatives such as efforts by the Chamber of Mines and the Mine Manager's Association to revegetate mine dumps should be encouraged and perhaps made compulsory. Such efforts ought to include problems of water and air pollution from these dumps. Biological stabilization of mine dumps should be intensified by using self-perpetuating grass varieties and other plants.

18. For effective implementation of the Interim Environmental Policy (a new initiative by the ministry responsible for the environment) there is a need for cooperation between environmentalists, the National Economic Planning Commission and the Zimbabwe Investment Centre. The aim of this cooperation should be to ensure that at least all new mining projects have appropriate decommissioning plans. It should be a requirement that a budget for environmental clean-up be made before a project is approved. In the face of the non-effectiveness of legislation alone, economic incentives and/or stiffer penalties could be additional instruments. EIAs should include biophysical, socioeconomic and cultural environmental impacts and should be done with full and open participation of the minerals industry and the affected population.

19. While environmental problems emanating from formal mines can be relatively easily addressed, it is the informal and illegal mining sector which presents the biggest quandary. While recent legislation to control gold panning (Statutory Instrument 275 of 1991) was an important step forward, there are difficulties in enforcing the relevant statutory instrument owing to lack of manpower and finance. Moreover, the instrument comes into direct conflict with some of the provisions of the Natural Resources Act, thus posing administrative problems. These problems could be overcome if consultation between the Ministry of Mines and the Ministry of the Environment and Tourism were to take place before regulations pertaining to mining and the environment are issued.

20. Formalization of the gold panning sector would, of course, make it easier to enforce regulations. The Government could set up gold buying points in the panning areas to purchase the output. With such a system, it would be easier for the authorities to insist on prudent environmental management, and it might even be possible to create a rehabilitation fund with a proportion of the proceeds.

21. Alternatively, diversification of the panners' economic base through the setting up of gold jewelry plants using the gold output and generating employment could be considered. To instil some sense of responsibility towards the environment in the minds of the panners, the Government, possibly with help of international organizations, could run pilot rehabilitation projects or provide pollution control equipment in selected panning areas. Workshops could sensitize panners to the dangers of degrading the environment. For the whole of the minerals industry, a rehabilitation/reclamation fund could be established, with a proportion of mining revenues being withheld to this end, as is done in Ghana, Chile and Mexico.

INTRODUCTION

22. The objectives of this report are, first, to outline the importance of gold mining to Zimbabwe's economic growth and development; secondly, to describe and examine the environmental effects of gold mining and processing in this country; thirdly, to critically evaluate the effectiveness of existing environmental regulations and expose any contradictions between the quest for economic growth and development and environmental management; and fourthly, to discuss the main

constraints facing Zimbabwe's minerals industry in managing the environment in a sustainable manner. In conclusion, the paper seeks to offer concrete recommendations as to how the Government, with concurrence from the whole of the mining industry, could mitigate adverse environmental effects of gold mining or at least ensure some environmental stewardship from all involved in minerals extraction. Ways in which existing regulations could be enforced or at least made enforceable are examined, highlighting the major constraints to effective environmental management in this country. Further, the report also considers the need for environmental regulations where they do not exist. In the light of monitoring problems and the limited effectiveness of regulations, the report recommends market-based instruments as an alternative.

I. TERMS OF REFERENCE

23. The present study is one of a series of country case studies on various commodities prepared within the UNCTAD programme on "Improved Natural Resources Management in the Commodity Sector". The programme consists of a series of activities which are linked together around the unifying objective of achieving sustainable use of natural resources while maximizing the contribution of the commodity sector to development. Country case studies undertaken under the programme have two main objectives.

(a) To formulate, against the background of practical experience, conclusions that can be applied in devising and implementing policies aimed at improving environmental protection and natural resource management in the commodity sector in developing countries.

(b) To raise awareness in commodity importing countries, funding agencies and the international environmental community of the opportunities for and constraints against the improvement of environmental conditions associated with commodity production and processing in developing countries.

24. It is of particular importance to identify and clarify the interactions between environmental and natural resource policy objectives, on the one hand, and short- and long-term economic policy objectives such as economic growth and export expansion, on the other. The present study attempts to:

(a) Identify the specific environmental effects of gold production in Zimbabwe;

(b) Identify global and sector specific economic and trade policies such as those implemented for economic growth, foreign exchange generation and revenue generation, with an aggravating or ameliorating impact on these environmental effects;

(c) Describe present measures aimed at dealing with such environmental effects;

(d) Evaluate the effectiveness of these measures in the light of the policies and investigate the causality and interplay between objectives, measures and the environmental effects of gold production;

(e) Assess whether the desired environmental objectives could have been attained more effectively through other means or under more favourable economic conditions; and

(f) Draw conclusions which, to the extent possible, should allow generalizations to be made which may be of use also to other countries.

II. MINING IN ZIMBABWE

25. Mining has long been an important industry in Zimbabwe. The earliest iron smelting sites have been dated to the second century AD and the first mention

of gold from the east coast of Africa is made by Arab geographers in the tenth century (Jourdan, 1990). In the sixteenth century, the Portuguese traded gold from the mines of Munhumutapa in present day Zimbabwe (Maponga, 1993). European subjugation of Zimbabwe was carried out by a mining company in search for gold which was thought to be on the scale of the Witwatersrand gold reefs in South Africa (Jourdan, op. cit).

Table 1: Zimbabwe, Basic Minerals Sector Data

Year	Total GDP[a]	Mining % of GDP[b]	Total labour ('000)	Mining % of total labour	Total Exports[c]	Mining % of Exports	Total GFCF[d]	Mining % of GFCF
1979	2650	9	934.7	6	715.7	37	395	21
1980	3224	9	1001.0	7	909.2	47	528	16
1981	4049	6	1037.8	7	971.7	37	830	16
1982	4657	5	1046.0	6	968.4	42	1 039	9
1983	5432	7	1033.4	5	1150.2	42	1 238	7
1984	5649	6	1036.4	5	1453.0	40	1 186	7
1985	6503	5	1055.0	5	1795.5	39	1 133	3
1986	7408	6	1081.1	5	2170.3	43	1 312	4
1987	8019	4	1083.2	5	2371.4	44	1 673	7
1988	10184	7	1131.2	5	2965.9	47	2 031	8
1989	12114	5	1166.7	5	3267.3	47	2 402	5
1990	14702	5	1192.2	5	4231.4	39	..	
1991	19587	5	1244.4	5	5544.9	37	..	
1992	25706	5	1221.5	5	..		..	

Sources: CSO Quarterly Digest of Statistics; IMR SADCC Database.
a/ Gross domestic product at factor cost in million Zimbabwe dollars.
b/ Mining GDP shown at mine rather than market value.
c/ Million Zimbabwe dollars
d/ Gross Fixed Capital Formation in million Zimbabwe dollars

26. Today Zimbabwe mines over 40 minerals of which gold is the most important. Other principal minerals produced in 1992 (by value) were nickel, asbestos, coal, copper, chromite, iron ore, tin, limestone and phosphate rock. The total value of mineral production (at mine value) in 1992 was 2,418 million Zimbabwe dollars (about 480 million US dollars, see table 2). This excludes the value of ferrochrome, pig iron, steel, cement, ceramics and coke.

27. The importance of mining to the economy is not fully illustrated by its share of total employment (5 per cent in 1992) or Gross Domestic Product (also 5 per cent in 1992); rather its most visible impact is its contribution to total export earnings (37 per cent in 1991) as shown in table 1. Its share of Gross Fixed Capital Formation (GFCF) has remained relatively low, dropping from a high of 21 per cent of total GFCF in 1979 to a low of 5 per cent in 1990. This illustrates the declining interest in the mineral sector during this period, a feature exacerbated by a chronic foreign exchange shortage. From the late 1980s, however, the country has experienced a boom in exploration expenditure as what were long perceived to be obstacles to investments have been gradually eliminated.

III. GOLD MINING IN ZIMBABWE

A. Geology

28. The greatest proportion of gold produced in Zimbabwe has been obtained from the Zimbabwean Craton which forms the Central Plateau of the country. Minor production has also been recorded from the younger, Proterozoic rocks and from recent alluvial deposits while increasing quantities of alluvial gold are being recovered from recent river gravels especially along the Mazowe and Umzingwane river basins.

29. Zimbabwe is mainly underlain by pre-cambrian rocks comprising the predominantly undeformed Zimbabwean craton of Archean age in the central, eastern and south-western extremity of the country, bordered on the south by strongly deformed rocks of the Limpopo mobile belt also of the Archean age and on the north by relatively younger Magondi Supergroup rocks (Forster, 1981). The craton consists of greenstone belts, tonalites, granites and granitic gneisses. The greenstone belts host the majority of gold deposits in the country. The belts consist of thick sequences of volcanic rocks which pan upwards within the succession into sedimentary rocks. The volcanic rocks are represented by the weakly metamorphosed komatites, basalts, andesites and rhyolites. The sedimentary rocks are mainly made up of cherts, greywakes, banded iron formations and some minor limestones. The vast majority of gold deposits are of the vein and shear zone type within the volcanic rocks of the greenstones in which quartz is the dominant mineral. Gold also occurs in finely disseminated form in volcaniclastic sediments in the banded iron formations. The latter type of deposit is normally oxidic near the surface and sulphidic at depth and is the type worked by most small-scale operations near the surface. Gold mining in Zimbabwe is widespread and methods vary according to the parent geological formations.

B. Production and marketing of gold

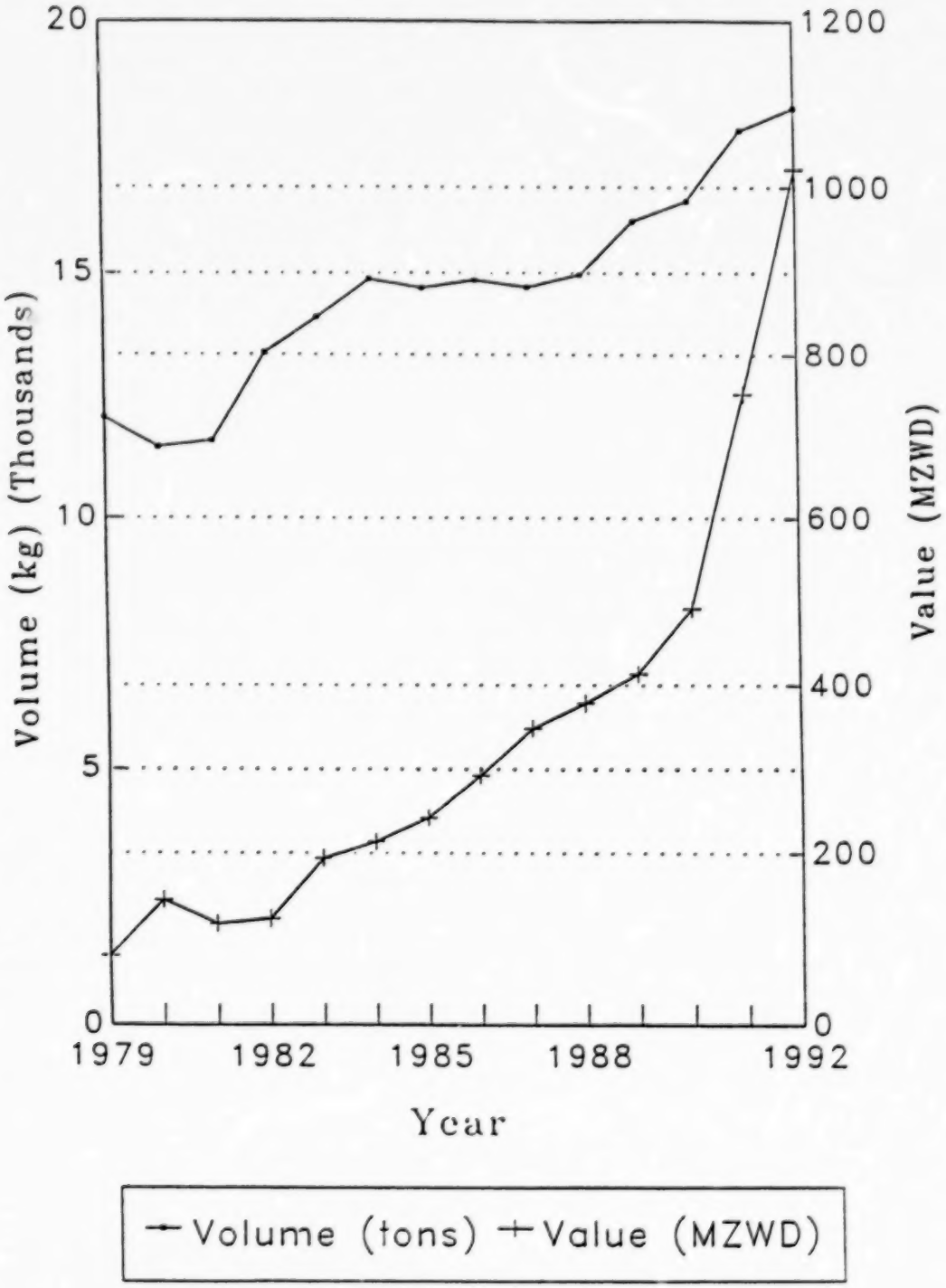
30. The majority of gold deposits in Zimbabwe were first exploited by Africans and later also by the Indians and Portuguese from approximately 600 AD to the 1800s (Forster, op. cit). It is estimated that in the 1,200 years preceding European colonization, about 400 mines produced between 600 and 800 tons[2] of gold (Jourdan, op. cit.). The first recorded gold production in Zimbabwe occurred in the Odzi and Masvingo districts in 1892 and national output rose rapidly to 600 000 ounces (18.7 tons) by 1907. It reached an all time peak of 930,000 ounces (28.9 tons) in 1916. Thereafter there was sustained decline to an all time low of 335,000 ounces (10.4 tons) in 1974 (Forster, op. cit.). Higher gold prices halted this declining trend slightly, although the unstable political situation must have acted as a deterrent to increased production during that period.

31. By 1977 there was a definite upswing in production with a slight dip from 12.5 tons in 1979 to 11.7 tons in 1981. Gold is the only mineral that has exhibited consistent increase in both volume and value after independence in 1980. Official gold output continues to increase (Figure 1) as the 'informal' (artisanal) mining sector becomes much more formalized and new technologies make once uneconomic mineral occurrences viable.

32. The total quantity of gold produced in Zimbabwe from 1890 to 1992 amounted to 1582.9 tons, averaging just over 15.5 tons per year from over 8 000 mines and small workings around the country. In 1992 alone, Zimbabwe produced 18.28 tons of gold, from about 1,000 registered mines, an increase of 3 per cent over the previous year's production (1993 production was expected to surpass 19 tons). Production from the large-scale mines continues to increase with Cluff Resources-owned Freda/Rebecca being the largest producer at over 2.2 tons in 1992, a 23 per cent increase over 1991 production. Other notable producers are Renco (Zimbabwe's largest underground mine), How, Redwing, Dalny, Shamva, Anzac, Patchway and Arcturus.

33. Small-scale miners who comprise single owners, cooperative producers and tributors of small gold deposits are also important contributors to overall gold production in Zimbabwe. The contribution of the small scale mining sector (less than 50 kg per annum) to official gold output has risen dramatically in the last

Figure 1: Volume and Value of Gold Production 1979 to 1992



five years from a mere 5 per cent in 1988/89 to about 30 per cent in 1993. The rise in the sector's official contribution is mainly due to the formalization of the originally illegal miners.

Table 2: The Significance of Gold Mining in Zimbabwe: Exports, Production and Labour (1979-92)

Year	Mineral Exports[a]	Gold exports as % of total	Mineral Production[a]	Gold production as % of mineral production	Mining labour	Gold labour as % of mining labour
1979	263.8	25	314.8	26	61 154	23
1980	428.4	27	414.8	35	68 793	17
1981	360.2	21	393.5	30	69 038	17
1982	408.7	34	383.0	32	60 372	22
1983	479.6	22	470.5	41	52 206	27
1984	574.7	28	546.5	39	53 711	28
1985	698.1	29	629.6	38	52 941	28
1986	933.0	44	699.4	42	55 231	27
1987	1 040.4	42	815.6	43	58 464	25
1988	1 381.1	28	985.7	39	57 660	26
1989	1 539.2	33	1 197.0	35	59 986	27
1990	1 663.9	35	1 336.6	38	60 198	27
1991	2 025.5	38	1 852.0	41	60 275	30
1992	3 024.4	34	2 418.7	42	59 471	31

Sources: CSO Quarterly Digest of Statistics; CoM Annual Report; EIU Country Reports- Malawi and Zimbabwe, issues 1986-93; IMR SADCC Database.
a/ Million Zimbabwean dollars.

34. Gold is an important mineral to Zimbabwe's economic well-being. Table 2 gives a clear picture of the importance of gold to the Zimbabwean mining sector in terms of exports and employment. Gold is undoubtedly the outstanding mineral in Zimbabwe, with the greatest value, highest workforce and largest number of mines. Since 1979, gold has replaced asbestos as the major mineral foreign exchange earner, contributing, on average, 29 per cent of mineral export earnings between 1979 and 1992 and 36 per cent since 1986. Gold also remains the major employer within the formal mining sector, accounting for an average of 25 per cent of total formal mining employment. However, the contribution of gold mining to total mining employment is under-estimated, as this figure does not take into account the alluvial gold panners whose number has been estimated at anything up to 100,000 (although probably not more than 25,000 at any one time) per season.

35. In Zimbabwe, gold is produced by both large-scale producers and by numerous small-scale miners whose number has increased dramatically since independence in 1980. However, the bulk of Zimbabwe's gold comes from large-scale producers. The major gold producing companies in Zimbabwe are Lonrho (from How, Arcturus, Athens, Shamva, Muriel, Tiger Reef, Redwing, Anzac mines), Falcon Gold (from Dalny, Venice, Old Nic, Dawn, What Cheer mines), Cluff Resources (from Freda-Rebecca, and Peach Tree mines), Falconbridge (from Blanket, and Golden Kopje mines), Union Carbide (from Gaika and Lennox mines) and Riozim (from Renco, the largest underground gold mine in Zimbabwe, Patchway, Brompton, and Cam and Motor mines). In 1992, some 56 per cent (9,892 kg) of gold was produced by only 18

mines with an annual output of over 200 kg each, while 30 producers with between 100 and 200 kg produced 20 per cent and the remaining mines produced 24 per cent of total gold output.

36. However, not all production from the vibrant but illegal small-scale miners including alluvial panners is accounted for, since most of the output is lost to the parallel market. This is estimated to have lost the country an estimated 100 million Zimbabwe dollars (15.4 million US dollars[3]) in 1992 (a rise of over 50 per cent from the 1989 figure) in foreign exchange.

IV. ENVIRONMENTAL IMPACTS OF GOLD MINING

A. Overview

37. The environmental impacts of gold mining and processing in Zimbabwe can be grouped into two sections: those that originate from formal mining operations and those arising from informal ones (including alluvial gold panning). While most of the serious environmental damage is believed to emanate from the alluvial panners as most of them are uncontrolled and illiterate and uninformed, formal miners have also been serious offenders and their actions are likely to be due more to negligence than anything else. In both cases, the environmental degradation results from mining and mineral concentration operations and from day-to-day interaction with the surrounding environment.

B. Gold panning and the environment

38. Since Zimbabwe's independence in 1980 there has been an upsurge in gold panning along the country's major rivers; a gold rush phenomenon has emerged and has been fuelled by a number of factors, not least among them the high levels of unemployment following worker retrenchment, the large number of school-leavers and poor yields from peasant farms. Gold panners estimated to number up to 100,000[4] per season have become a common sight along the Mazowe, Runde, Insiza and Umzingwane rivers which drain the major gold-rich greenstone belts. Panning has also been fuelled by the known existence of free gold along these rivers. Gold panning is also observed to increase after agricultural harvests as peasant farmers seek to supplement income by panning for and selling gold. In addition, panners have also invaded mine-dumps[5] where they rework the slimes and transport them to nearby water courses/sources for panning.

39. Panning for gold has had serious environmental and ecological effects from both the recovery of gravels and the freeing of gold (processing). The major negative results are:

- River siltation and land disturbance,
- Mercury poisoning,
- Deforestation,
- Sanitation and housing problems, and
- Unprotected mine-shafts, human dangers from collapse

Land disturbance and river siltation

40. Panning involves digging up river beds using picks and shovels to expose mineral bearing gravels. This means that huge mounds of material are moved from the river beds and banks to enable the gold bearing gravels to be flushed out with water jets. Buckets are then used to collect the gravels which are sieved to recover free gold. The result is a disruption of the river beds and banks with holes and trenches being created all over the place. Large amounts of earth are subsequently transported by the water and deposited at various points along the water courses including dams and reservoirs, especially problematic during the rainy season, causing blockages and changes in the surface water system. The high sediment load has been known to suppress aquatic life through reduced light and filter feeding mechanism (Whitlow et al., 1988)

41. The search for gold is concentrated not only along the river channels but

also in areas surrounding the channel flow, especially the flood plain. Vegetation removal is rampant in such areas since trees and shrubs are felled to expose silt which is believed to contain gold nuggets. Flood plain areas are thus punctuated with pits and trenches which the panners seldom cover. The cutting down of trees and the general stripping off of the vegetation results in soil erosion, as the top soil becomes exposed. The creation of gullies in panned-out areas is therefore a common sight. This also results in further siltation of rivers and other water bodies, disrupting the downstream flow of water.

Mercury poisoning/pollution

42. Small-scale gold mining, especially panning, is well known for its use of mercury to recover gold. It is estimated that between 300 and 500 tons of mercury per year, corresponding to 10 per cent of total mercury production, are used by the small-scale mining sector to recover gold around the world (Priester, 1992).

43. The process of gold recovery using mercury is called amalgamation. After sorting out the gold-bearing gravels with panning dishes, the material is alloyed with liquid mercury. The mercury amalgam is then heated to vaporize the mercury and free the gold. During vaporization the mercury is released into the atmosphere and usually finds its way into the food chain and finally to human beings and animals. Though a recent phenomenon, mercury use in amalgamation and on-the-spot testing of fine gold is becoming common in Zimbabwe[6], most probably because of the process's simplicity, the low investment requirement and the high recovery values. This is illustrated by the rise in the thefts of mercury thermometers from schools, laboratories and hospitals. The release of this excess mercury into both water systems and the atmosphere probably accounts for the emergence of mercury related diseases in Zimbabwe as the vapour contaminates the atmosphere around panning areas[7].

44. The problem of mercury contamination is further exacerbated by the lack of proper knowledge on its use. This sometimes leads panners to believe that the more mercury they use, the more gold they are likely to recover. Mercury vapour inhalation is commonly associated with colics, vomiting, gastroenteritis and ulceration of gums.

Deforestation

45. Though most gold panners live nomadic lives, moving between the panning areas and their communal homes, some live permanently next to sources of alluvial gold. Temporary settlements have sprung up in the vicinity of water channels as panners move closer to the panning areas after harvesting their crops. The day-to-day productive activities at these mining settlements, as well as their energy and housing requirements, result in environmental degradation and atmospheric contamination.

46. The excessive reliance on wood as a source of energy results in the cutting down of trees around these areas. Zimbabwe is reported to use more than four million tons of wood as fuel per year, which is equivalent to 100,000 hectares of land being cleared yearly (Chivasa, 1993). Trees are also cut for building materials and for sluices and panning trays. The main consequences, as already highlighted above, are erosion of the top soil left without cover and the resultant gulleys and expanses of unusable land.

Sanitation and housing

47. Since most of the homes in the alluvial gold panning areas are temporary, no attempt is made to install proper sanitary facilities. Littered with human waste and domestic garbage, such places pose a health hazard to workers and their families. Although no statistics exist, cases of dysentery, bilharzia, diarrhoea and other water-borne diseases have been reported in panning areas. Social decay has also been reported to be rampant in these areas.

48. As economic conditions worsen and people look to gold panning as an alternative source of income, urbanization problems arise along the alluvial gold sources. The problem of squatters is also a very common feature along the Mazowe and Umzingwane rivers as more and more people move into these areas looking for gold.

49. The reworking of abandoned mine shafts by panners has created dangers to human beings since the panners do not construct adequate supports for the underground workings. Collapses of these shafts have led to a number of serious injuries and some deaths.

C. Formal gold mining and the environment

Background

50. The formal gold mining sector comprises small, medium and large scale producers registered with the mining commissioners. Their negative effect on the environment is due to neglect rather than ignorance. Environmental problems resulting from formal gold mining and processing include cyanide contamination, deposits of mine effluent/slimes, failure and inadequate management of tailings dams, disposal of solid waste, emission of particulates and gaseous matter into the air.

Solid waste disposal

51. Mining results in huge mounds of solid waste accumulating in the vicinity of the mine. For open pit gold mining, serious environmental degradation arises owing to the huge amounts of waste rock being disposed of. With the high stripping ratios which are a common feature in most low grade mines (for example Freda/Rebecca* has a stripping ratio of 6:1 from its two pits) disposal of waste becomes a problem. The mines eventually start to encroach on agricultural land next to the workings, people living in close proximity are displaced, leading to further environmental degradation as people seek to establish new homes. Solid waste also destroys and inhibits growth of vegetation and thus changes land-use patterns.

52. An additional problem is the amount of dust produced. This dust spreads over large areas of the surroundings, since at many mines no dust screens are provided, covering much of the plant life. This not only retards growth, but also renders such plants unsuitable for animal and livestock consumption.

Tailings dam management

53. Tailing ponds present serious environmental problems not only at gold mines but at all mining locations. There is a need to find permanent and economic methods of stabilizing tailings dams to avoid bursting and hence pollution of surface and subsurface water. If dams are not lined with impermeable material, tailings pond material can escape and contaminate the water system. Mechanical failure of dumps needs to be minimized by constructing ponds to technical specifications since, on escaping, tailings become an environmental hazard. Generally, treatment ponds and effluent disposal systems are poorly managed, such that contaminated water easily leaves the tailings ponds. In 1993, a number of soldiers who had settled at an abandoned mining location died after drinking water contaminated by leakage from tailings ponds. In this case the contaminants were suspected to have leaked into groundwater rather than surface water.

Cyanide contamination

54. Most mines use cyanide leaching for recovery of gold. The use of cyanide is dictated by the occurrence of gold in low concentrations in deposits which makes recovery by any other method uneconomic. Cyanide leaching which has higher recovery rates is thus considered appropriate by gold producers. There is no economically viable replacement for cyanide in precious metal leaching at

present, nor is one expected to be developed in the foreseeable future. Consequently, the stabilization of cyanide contamination remains an important environmental requirement. There is a need for the enforcement of cyanide detoxification in all gold-plant tailings prior to their use in mined-out stopes as backfill.

55. Most gold mining companies in Zimbabwe immobilize cyanide by treating the tailings with ferrous sulphate to form a ferro-cyanide complex which is a much weaker solution and decomposes to a sulphate which is essential for plant life. The complex is unstable at high temperatures and high pH and can decompose under ultra violet light. If it does not decompose, however, the ferro-cyanide complex can build up in the tailings and escape to contaminate groundwater. According to a study by the Department of Natural Resources, 64 per cent of gold mines studied in one of Zimbabwe's mining districts have 'poor chemical management' (Shoko et al. 1993). Small companies, because of financial constraints, cannot optimize the use of ferrous sulphate, and consequently the ferro-cyanide complex is not well diluted and causes direct contamination of surface and subsurface water. Furthermore, some small mines have virtually no disposal systems for the used solution and some of it finds its way into the river systems, posing danger to human, aquatic and animal life. Although regulations which forbid the disposal of cyanide solution into the river systems exist in the Mining and Safety Regulations (1981), compliance is at best minimal.

56. The effectiveness of cyanide control systems is constrained by the inadequacy of manpower and technical systems both within the Ministry of Mines and the Department of Natural Resources. Hence, the monitoring of pollution or compliance with regulations is left to the individual company. Furthermore, the Mines and Minerals Act, which supersedes almost all other legislation concerning mining activities, has been criticized for providing exemptions which allow pollution to go on and for emphasizing 'immediate economic gains' (Shoko et al., op. cit.).

Arsenic poisoning

57. Another area of concern is the emission of toxic gases into the atmosphere from roasting of ores that are not amenable to leaching. The roasting plant in Kwekwe, a parastatal operation, was formed by the Government in collaboration with the minerals industry for the purpose of processing such refractory gold ores. It would have been too expensive for individual mines to have their own roasting plants, given the low volumes of refractory ores. The environmental problems in gold processing at the plant are caused by arsenic trioxide emissions from the roasters. From the road, arsenic oxide fumes can be seem emanating from the stacks of the plant. Arsenic is known to be a poisonous substance to humans, plants and animals. It causes degeneration of the lining of the digestive tract and tissues of other internal organs, and also attacks the central nervous system directly. There has, to date, been no effort to install scrubbers or other devices to reduce the emission of toxic gases from this plant.

Mine dumps management

58. Environmental problems resulting from mine dumps include siting of the dumps, erosion from unvegetated dumps, and the bad visual impact created by the dumps. The most common sight at mining operations in Zimbabwe is bare and eroded mine dumps presenting an ugly scar on an otherwise beautiful landscape. Erosion causes siltation of waterways and rivers and the formation of gullies in biologically unstable dumps. Proper dump management requires revegetation or terracing to avoid erosion by surface run-off. The erosion of bare and unvegetated mine dumps by water and wind has affected local areas around mines in Zimbabwe by, for example, burying land under deposited dump sediment as well as coating plants in dust. For mine dump revegetation to be effective, there is a need for mines to carry out research into the most suitable vegetation.

59. There are lessons to be learned from some mines in Zimbabwe where successful revegetation programmes have been implemented. Patchway is one such

mine: hydromulch (a mixture of grass seed, manure and fertilizer), acacia trees, and vetiver grass from Australia are used there as vegetative cover. Results from the initial revegetated dump are encouraging and should be emulated by other mines around the country. What is encouraging in Zimbabwe is that, in the absence of strict revegetation regulations, most large mining companies have taken the initiative to revegetate their dumps anyway and to make this an ongoing process.

60. Other environmental problems associated with gold mining and processing are lead poisoning, land subsidence, noise pollution, dust pollution and dangers posed by unprotected mine-shafts.

61. Gold also occurs in base-metal sulphides, especially those of nickel and lead, and their processing results in unstable compounds of sulphur being released into the atmosphere. Unless methods for capturing these stack emissions are employed, air pollution is the result.

62. Another hazard is the abandonment of unprotected shafts, adits, and trenches left by miners. This poses threats to wildlife and human beings. Land subsidence has often occurred since some underground openings are not backfilled, although a significant number of mines do make it a point to backfill their excavations.

V. THE ENVIRONMENT, ECONOMIC DEVELOPMENT AND LEGISLATION

A. Background

63. The mining sector plays an important role in the country's overall economic growth and development; therefore most policy prescriptions are designed towards extracting optimum benefit from mining, processing and marketing. However, economic growth policies at times come into direct conflict with sound environmental management and sustainable development. Zimbabwe has not emphasized the formulation of policies accommodating the two policy objectives. Growth objectives have not been juxtaposed with environmental management policies. Where there is conflict it seems that economic considerations often take priority while environmental concerns are relegated to the "back seat".

B. Mining, economic growth and development

64. The growth of the mining sector has been at the centre of Zimbabwe's overall economic growth and development strategy, in view of the important role which the sector plays. Policies to enhance the sector's growth have formed part of the Government's principal strategies through the National Development Plans, characterized by a resource-based industrialization strategy using mining as the driving force. The major policy initiatives for growth of mining which have had negative environmental impacts, directly or indirectly, are:

- Increased mineral beneficiation,
- Export promotion programmes,
- Gold stabilization scheme,
- Economic structural adjustment programme,
- The roasting plant,
- The new investment code, and
- Legalizing gold panning.

Mineral processing

65. To arrest declining terms of trade of raw materials, the Government has encouraged local mineral processing to capture as much value added as possible. Prior to 1989, gold refining had to be done in South Africa, a state of affairs inherited from the previous Government. The Government sought to increase earnings from gold production and thus commissioned the country's refinery in 1989. The problem of fumes emanating from gold refining was not incorporated into the cost/benefit analysis of the project, albeit no specific complaints have as

yet been raised about pollution from the plant.

Export promotion programmes

66. Zimbabwe, like most developing countries, suffers from acute shortage of foreign exchange needed to service the highly import-dependent economy. The mining sector is one such sector where almost all the mining machinery and equipment has a high imported content. Foreign exchange shortage has greatly constrained expansion of the mining industry because companies could not re-equip. The same constraint has also meant that companies have been unable to purchase the latest environmentally friendly mining and processing technology from industrialized countries.

67. It was against this background that the Zimbabwean Government introduced an export promotion programme (EPP) under which exporting companies would be entitled to some preferential treatment in obtaining the much needed hard currency. It is not surprising that for the mining sector, gold received the lion's share of the allocation. For example, under the EPP (or its other derivatives, Mining Continuation Reserve (MCR) and Export Revolving Fund (ERF)), gold received over 35 per cent of total foreign exchange allocations between 1986 and 1991 so as to import machinery and spares. This led to a continued expansion of the gold mining sector. Zimbabwe's largest gold producer, Cluff's Freda/Rebecca opened after the introduction of the EPP and most certainly the company was able to repay the 14 million Zimbabwe dollars (then about 8 million US dollars) loan it had borrowed overseas because of this facility. Because it was an open pit operation, the potential for environmental degradation was immense as the mine also encroached on farming areas. An environment impact assessment was carried out and although it was largely academic (since there is no official requirement for EIAs), it illustrated a certain commitment to some form of environmental management by the company.

Gold stabilization scheme

68. To stimulate gold production in Zimbabwe in the face of low international prices and to stimulate increased gold exports (to increase foreign exchange revenues), the Government introduced a gold stabilization scheme under which gold producers were guaranteed a floor price, reached after consultations between the Ministry of Mines, Chamber of Mines and the Reserve Bank of Zimbabwe. The policy was introduced at a time when international gold prices were not attractive to local producers and were subject to major fluctuations. Under this scheme (which remains currently operational), gold producers are assured a guaranteed floor price. When the international price is higher than the local floor price, 25 per cent of the price difference has to be paid to the Reserve Bank of Zimbabwe to cover expenses under the floor price scheme. This policy acted as a strong stimulus to increased gold production and as a result there was a dramatic increase in gold output from legal operators. It also acted as stimulant to the formalization of some hitherto illegal gold mining operations. It was the formalization of the once illegal (mostly gold panning) mining activities, that also resulted in an upsurge in panning, with consequences mentioned elsewhere in this study (see paragraphs 74-78).

Economic Structural Adjustment Programme

69. In the face of declining economic growth and a deteriorating balance of payments position, an Economic Structural Adjustment Programme (ESAP) designed by the IMF/World Bank was introduced in late 1991 by the Zimbabwean Government. The salient features of the policy were/are: devaluation of the Zimbabwean dollar, which was regarded as overvalued, decontrolling of interest rates, liberalization of the labour market, reduction in government expenditure and general economic liberalization. The immediate result was that as soon as they were freed, interest rates soared and for the first time in many years the country experienced positive real interest rates. The levels of interest rates, however, took most 'overborrowed' companies by surprise. Many companies (both large and small) could not afford to borrow at the prevailing interest rates and

were forced to scale down operations. Some of them have since closed permanently. The most immediate effect was a cut-back in capital expenditure and a postponement of major investment programmes, some of which included importation of environmentally friendly equipment.

70. Another result was massive worker retrenchment from almost all sectors of the economy. To date, over 100,000 people have been retrenched and over 200 companies liquidated since the introduction of ESAP. Many of these retrenchees, especially those from the mining sector, have invaded the gold rich river beds to look for gold.

The roasting plant

71. The Government's aim in setting up the roasting plant in Kwekwe was to enable mining companies to process refractory ores economically by exploiting economies of scale. Though the negative impacts of arsenic were understood at the time, the Government's aim was to be able to process such ores and generate income from the fees paid by mines and from the sale of gold. As discussed earlier, arsenic trioxide fumes can actually be seen at a distance as one approaches the plant. Although attempts to minimize these effects are being made, contamination from arsenic still persists.

New investment code

72. To address a yawning investment gap in the mining sector and the resulting low levels of economic growth, the Government introduced an investment code in 1989 (since revised in 1991 and 1993) designed to streamline the country's investment climate and make it competitive with other countries. The emphasis in the new investment code has been on attractive remittance packages, a relaxed taxation regime, foreign currency retention and deregulation of the labour market. This has resulted in an upswing in investment in both exploration and mine development. A record number of Exclusive Prospecting Orders has been taken out by both local and foreign mining companies, mainly for gold and diamonds in the last two years. While aspects such as socioeconomic benefits to rural sectors, employment generation, intensive use of raw materials and technology transfer are some of the criteria used to assess the desirability of a new project, a glaring omission is the absence of any specific mention of environmental impact. The policy actually emphasizes intensive use of local raw materials without any mention of the sustainability of such use. The need for increased investment and generation of employment has tended to overshadow environmental issues. When the environment is mentioned, it is almost invariably only in passing.

73. The mining sector has undoubtedly expanded in the last two years in response to the new incentives. However, the environmental impact of increased mineral exploration is not to be underestimated, particularly in virgin territory. Only the efforts of private environmental groups have forced most companies to take more care in both exploration and mining than they normally would have.

Legalization of alluvial gold panning

74. Through Statutory Instrument 275 of 1991, panning for alluvial gold in public streams was legalized. The regulations were drawn up at a time when a lot of concern was being expressed over the intensity of panning activities around the country and the resulting destruction of the surrounding areas. The Government's aim was two-pronged: first to control panning activities and maybe reduce them through strict regulations, secondly, to capture revenue from these operations by forcing the panners to sell their output to the Reserve Bank of Zimbabwe. The results have been a massive increase in the number of alluvial gold panners, leading to high levels of environmental problems.

75. First, the regulations are in direct conflict with those of the Natural Resources Act. The former allow panning on the beds of public streams but not

on the banks, while the latter prohibits any activity within three metres of the river banks, although before a permit to pan is granted the Natural Resources Board is to be consulted.

76. Secondly, there have been problems in monitoring the activities themselves. The rural district councils that have been charged with keeping records of the activities pertaining to alluvial gold mining within their jurisdiction do not have the expertise or resources to deal with such a task.

77. Thirdly, the problems of selling to official outlets were not addressed since the Reserve Bank did not locate buying offices close to the sites of the panning activities.

78. Although the regulations specify exact places where panning should be undertaken along the rivers - such as the river bed and three metres from the banks - these specifications have proven difficult to enforce. Not only are panners unable to comply with regulations regarding panning sites, but they seem not to care about backfilling mined-out areas. Since no national register of panners exists (although required by the regulations), a panner can easily move with inpunity from an area where he has been blacklisted to another. In short, this legislation is proving difficult to enforce. What has become clear is that the government objectives in instituting this legislation have not been achieved. Instead, degradation has occurred.

C. Mining, the environment and legislation

Overview

79. There are in existence legislation, regulations and standards concerning mining and the environment in Zimbabwe. At present the legal and policy instruments that directly and indirectly affect mining and set environmental standards include:

- Mines and Minerals Act,
- Natural Resources Act,
- Hazardous Substances and Articles Act,
- Water Act,
- Mining (Alluvial Gold) Public Streams Regulations (1991),
- Mining (Management and Safety) Regulations (1981),
- National Development Plan, and
- Environmental Impact Assessment Policy.

Mines and Minerals Act

80. Mining and mineral processing activities fall within the domain of the Mines and Minerals Act, Chapter 165 (1961) which is administered by the Ministry of Mines. The Act controls prospecting for minerals, establishment of mines and execution of all mining activities. The Act overrides all the other acts dealing with mining. However, it covers only a limited range of environmental issues once a mining permit has been issued. The main criteria for issuing a permit are technical and financial competence. By ignoring pollution and other negative impacts on the environment, the Act as a result leaves the way open for extensive timber felling, dump erosion leading to siltation of dams and rivers, and non-compliance with quittance requirements when mines are closed.

81. Although section 399 (2) specifies that shafts opened during prospecting should be fenced and filled, a requirement aimed at rehabilitating all land disturbed during mining, this provision is rarely enforced; most mines are abandoned without any of these regulations being observed. Occupational and safety aspects are covered under the Minerals Act but Mining Commissioners charged with this task are often not very well equipped to monitor compliance.

Natural Resources Act

82. Within the framework of the Natural Resources Act (Chapter 150) of 1975 the Natural Resources Board (NRB) was established. Its functions are:

(a) To exercise general supervision of natural resources;
(b) To disseminate information on conservation and improvement of natural resources;
(c) To recommend to the State the nature of legislation or measures it deems necessary for proper conservation, use and improvement of natural resources.

83. The NRB is composed of members drawn from a whole spectrum of professionals, including representatives from various ministries. Under the auspices of the NRB exists an environmental agency known as the Mineral Resources Committee (MRC). Created in 1949 within the Ministry of Natural Resources, it deals with mining problems. The MRC is the only body outside the mining industry concerned with environmental impacts and conflicts associated with mining in Zimbabwe. The MRC evolved at a time when there was expansion from both the mining and the agricultural sectors (Whitlow, 1990) and conflicts arose between the two sectors as they infringed on each other's land. The MRC was instrumental in promoting dialogue between the farmers and the miners from 1950 onwards (Whitlow, 1990) and was helped in this endeavour by the Intensive Conservation Area (ICA) committees. The range of issues which the MRC has addressed is broad (see table 3). The MRC has for a number of years been concerned with problems of chromite mining along the Great Dyke, as it encroached onto the fringes of wetlands.

Table 3: Issues addressed by the Mineral Resources Committee of the NRB (1949-1982)

. excessive and illegal cutting of timber by miners and mine workers,
. cultivation by mine-workers of privately owned land,
. control of base metal prospectors, especially access to land,
. reservation of improved pasture against pegging claims,
. damage to and rehabilitation of areas affected by alluvial mining,
. erosion and siltation related to alluvial gold mining,
. erosion of mine dumps,
. water and air pollution associated with mines,
. hazards of surface mining, especially in livestock areas, and
. compensation to landowners for damage caused by mining.

Source: Whitlow, 1990.

84. The MRC has also been instrumental in analyzing the problem of mine-dump stability, both physical and biological. Since 1960 the MRC, with participation from the mining industry, has supported research into the most effective methods of stabilizing mine dumps, especially the dumps produced from arsenic-rich or sulphide ores (Whitlow, 1990). In 1980, the MRC, with participation from the Mine Managers Association, initiated an annual mine dump competition to promote environmental awareness and responsibility. Under this competition, dumps are judged on the basis of proper siting and construction, effective plant cover (revegetation) and any secondary hazardous effects. Patchway Mine (owned by Riozim) has won this competition more often than any other mine since the competition's inception 13 years ago. While the intentions are good, worst offenders deliberately absent themselves from the competition. It must be emphasized that the competition is voluntary and hence it has not led

to any significant reduction in the number of unvegetated and badly eroded mine dumps.

Water Act

85. Under the auspices of the relevant minister, the Water Act, Chapter 150, deals with the utilization of natural water sources and the sinking of boreholes. Section 101 of the Act deals with pollution of natural water bodies through the disposal of solid or liquid waste and is administered by the Minister through river boards. Under the same act, abstraction from water courses or bodies is permitted for the purpose of subterranean mine locations.

86. The Act makes the pollution of natural water courses a punishable offence. Mining wastes, like other industrial or agricultural wastes, should conform to minimum pollution standards set by the authorities within the Ministry of Water Resources. However, the same Act gives exemptions to compliance in special circumstances as determined by the Minister. The problem with the administration of pollution compliance standards is again the shortage of personnel needed to monitor effluent pollution levels. This is coupled with the fact that equipment to test and monitor pollution levels in groundwater is not available at most mines (although this would seem to be a minor issue, given the number of analytical laboratories in the country).

Hazardous Substance Act

87. The Hazardous Substances Act, Chapter 322 of 1971, is administered by the Hazardous Substances Control Board (HSCB) and deals with the licensing, supply and storage of hazardous substances. The Board controls the importation of hazardous substances; officers within the responsible Ministries enforce the Act. Members on the HSCB include appointees from the Ministries of Mines, Health, Agriculture, and Water.

88. Subsection 1 of the Act describes hazardous substances as any substance or mixture of substances which may endanger the health of human beings, domestic or wild animals, birds or fish by reason of its toxic, corrosive, irritant, sensitizing, inflammable or radioactive nature. Most chemicals used in the mining sector, including mercury, are classified as Group 1 Hazardous Substances which means that no one can import, manufacture, sell, possess, and/or store them without a permit from the Ministry of Health. This may be one of the reasons why the use of mercury has not become even more widespread in Zimbabwe.

Mining (Public Streams) Regulations

89. Instituted in September 1991, these regulations were designed to impose control over alluvial panning operations which were causing massive environmental problems and had led to a loss of foreign exchange income owing to gold being sold on the parallel market. As mentioned above, the regulations have been difficult to enforce and are also in direct contradiction with the Natural Resources Protection Regulations of the same year.

Mining (Management and Safety) Regulations

90. Mining (Management and Safety) Regulations, instrument 61 of 1981, deal with general safety at mining locations from initial discovery of a deposit to final disposal of the product. These regulations clearly set out the criteria for the appointment of mine managers who have to be ratified by the Chief Government Mining Engineer (CGME). Safety aspects covered in the regulations which relate to the environment include mine support, ventilation, construction of tailings dams and ponds, disposal and care of toxic substances.

91. Section 21 (1) of the regulations deals with cyanide and its storage. It states that it should be kept in a conspicuous and convenient place and that a sufficient supply of antidote should be kept at the mine. This section also

provides for the disposal of any cyanide solution; such areas should be securely fenced-off and water containing cyanide should not be allowed to escape into either groundwater or surface water without being adequately treated.

92. Section 23 (1) deals with the treatment of arsenic ores. These should be roasted in a properly designed and constructed roasting plant with adequate collection facilities for arsenic oxides and precautions should be taken to avoid poisoning of humans and of plant and animal life.

93. Tailings dam construction in terms of specifications, strength, stability and erection of penstock or spillway is dealt with in Section 25 (1) of the regulations. According to this section, tailings dams should be constructed under supervision by qualified personnel and should be inspected every seven days for any collapse or discharge of tailings.

94. On mine closure, the regulations specify that the areas should be securely fenced or locked to prevent access by both humans and animals.

National Development Plan

95. In its Second Five Year National Development Plan (SFYNDP) (1991-1995), the Government noted for the first time that the following problems had led to serious environmental degradation and that all efforts should be geared towards solving them:

(a) Mismanagement of the environment through rapid population growth,
(b) Unplanned illegal settlements in many areas and especially along tsetse-fly-free areas of the Zambezi Valley,
(c) Unplanned gold panning, and
(d) Implementation of development projects without environmental impact assessment.

96. Coming after about ten years of independence, the plan represented a new attempt to address the often neglected problems of environmental degradation. The Government's objective is to ensure utilization of the country's resources in an equitable, productive and sustainable manner. The plan seeks to balance economic development with environmental conservation so as to arrest environmental degradation. It was from this policy and the Rio Declaration that an Interim Environmental Impact Assessment Policy was born.

97. The main drawback of the plan was the absence of monitoring of new projects. Hence at the Zimbabwe Investment Centre, where most projects are approved, there is no requirement for an EIA; projects are approved on the basis of their economic and technical merits.

Environmental Impact Assessment

98. As a result of pressure from private environmentalists and interaction with multilateral bodies, the Government has recently begun to take a closer look at the environmental effects of both mining and manufacturing. The Ministry of the Environment and Tourism has been established. In line with Agenda 21 and the country's SFYNDP, Zimbabwe is in the process of drawing up guidelines for environmental assessment (EA) before project approval and during project life. The ultimate development of the Interim Policy which will be put to an initial two-year test will be done in consultation with all interested parties, especially the companies and communities affected. Workshops have already begun with a view to preparing the final document (see appendix I).

99. The policy in its final form will require specific plans for monitoring and managing the environment. These plans should include mechanisms for regular reporting. The Government recognizes that EIA is not a panacea; rather its effectiveness will depend mainly on the administration of the policy through licenses and permits. Significantly, the Interim Policy includes requirements for cost/benefit analyses. The Ministry of Environment and Tourism will be the overall administrator of the new policy with all agencies, including the National

Economic Planning Commission and the Zimbabwe Investment Centre, submitting their projects before final approval. As shown in appendix II, the channels for final project approval are clear and simple. However, the actual implementation of EIA is left to individual companies which could lead to a situation where companies look only at issues that matter to them.

100. This could produce misleading results, as restrictions on time and money may mean brief and superficial reports. Also since mining companies finance such studies, the possibility exists for tailor-made reports which play down apparent adverse environmental effects. Such gaps and grey areas need to be 'plugged' and addressed in time.

VI. DISCUSSION

101. Mining related environmental problems confronting Zimbabwe today are the result of the lack of implementation of existing regulations. The existing environmental regulations suffer from the lack of effective and efficient policing mechanisms, a problem common to all developing countries attempting to enforce environmental management in resource extraction and utilization. Effective policing of regulations in Zimbabwe is lacking because of the lack of financial and manpower resources to enforce the regulations.

A. Manpower and financial constraints

102. Shortage of manpower is one of the major constraints to the monitoring of environmental compliance in the country. For example, in every mining district (there are four mining districts in Zimbabwe), there is only one mining commissioner who is supposed to monitor compliance with mining regulations in all the mines. Given the number of mines in each district, the job of the mining commissioners and regional mining engineers is made difficult and hence some aspects of mining are not monitored at all. Not only are the numbers not sufficient to monitor such a huge mining industry, expertise is also lacking as there are no training institutions offering courses in environmental subjects, not only in Zimbabwe but in the SADCC region as a whole, with the exception of Botswana, which has just introduced such a course at university level.

103. Another obstacle to the enforcement of mining regulations has been lack of transportation to visit individual mines. This situation has been made worse by drastic cut-backs in government spending as a result of the ESAP. Even routine inspections to ensure compliance with basic safety regulations have had to be reduced. Effectively, this means that, even with trained personnel, monitoring of compliance with regulations is almost non-existent.

B. Legislative weakness

104. The existing legislation suffers from lack of enforcement and inadequate administrative and institutional capabilities. Because of the difficulty of enforcing the regulations, it has been left to willing individual corporations to practice some form of environmental stewardship. Contradictions among existing regulations make the whole system hard to police and enforce adequately.

C. Development and environmental management

105. For the utilization of resources to be sustainable, there is a need to balance growth and development objectives with sound environmental management. While it might be difficult to achieve the two at the same time, accommodating policies would go a long way towards bridging the gap. One instrument, especially relevant for new projects, could be to insist on detailed decommissioning plans and some form of reserve fund for environmental clean-up. All feasibility studies should include a budget item concerning the environment.

106. In the case of the small scale mining sector, the viability of which may be threatened by strict environmental regulations, education should be the first step towards ensuring prudent use of resources. In addition, the economic base of the miners needs to be diversified to include environmental clean-up as an occupation.

107. Environmental auditing of new economic policies is essential. In this context, ESAP needs to focus not only on growth but also on environmental management. The growth perspective has tended to overshadow sustainable development, an unhealthy state of affairs.

VII. CONCLUSIONS and RECOMMENDATIONS

108. Mineral development is of great economic importance in many countries, including Zimbabwe, since it provides employment, generates wealth and foreign exchange earnings, and supplies raw materials and energy central to the maintenance and improvement of living conditions. Mining has played a key role in the development of Zimbabwe since early times. Because of the shortage of capital to exploit the rich mineral resources, Zimbabwe, like most developing countries, has looked towards transnational corporations to build productive capacity. In the 1980s, mining and mineral processing was subject to stringent environmental controls in the developed world. In contrast, mineral-rich developing countries have had, or have been willing, to accept long-lasting environmental degradation in return for the economic benefits derived from mining. Zimbabwe's position in this regard is intermediate, as the country is moving strongly towards stricter environmental regulations with some form of auditing of past records. As a late-comer, Zimbabwe is facing problems in instituting enforceable regulations.

109. The problem with environmental management in Zimbabwe is compounded by the lack of clear and well-defined parameters within which mining companies are to operate. As a result, environmental management has been left to the individual mine operators and managers. The few regulations that exist in Zimbabwe are not enforced for reasons already mentioned. Being a developing country with an investment gap, strict environmental regulations have long been viewed as an impediment to foreign capital inflow, leaving any environmental stewardship to the conscience of the individual mine operator.

110. This survey has shown that environmental benefits would result if the existing legislation in Zimbabwe were tightened up. In particular, those sections of the Mines and Minerals Act which touch on environmental issues should be amended to make them consistent with regulations in other Acts that deal with the environment, specifically the Natural Resources Act and the Water Act.

111. Most international companies already possess environmentally benign technology and are quite willing to use it if so required. This is illustrated by the fact that all post-independence (since 1980) investments in mining have carried out some form of EIA. What actually has been implemented, however, has depended less on what the State required and more on what companies preferred to do. In all cases, the State did not set pre-conditions and therefore companies have gone ahead and implemented what they deemed fit and what they could afford.

112. Another issue that must addressed is the participation of the communities likely to be affected by mining operations. A step in the right direction - although open to criticism - has already been taken with the passing of the Mining (Alluvial Gold) (Public Streams) Regulations of 1991. These regulations put responsibility of monitoring gold panning on the local authorities. It is important, however, to go beyond merely assigning responsibility; the rural district councils must also share in the revenue that accrues from the mining activities so that they will have the means to implement regulations.

113. Individuals who have studied gold panning propose letting more established companies do the mining using more mechanized and supposedly more environmentally friendly methods. Foremost among these methods is dredging which

has already proven a success in New Zealand (Holloway, 1993). The advantage would be ease of accountability for impacts on the environment as it is much easier to monitor a few large-scale operators than numerous panners. The drawback is that it does not solve the basic problems which gave rise to panning in the first place. This is a potentially explosive political issue and will need tactful handling.

114. Another important point would be the introduction of an environment component into all the mining and mineral processing disciplines at Zimbabwe's tertiary institutions and the setting up of technical structures with effective means and authority having training of personnel as a priority.

115. Many corporations have made a commitment to environmental stewardship a part of their global policy. As a result, they have successful programmes in place to accomplish the goals. A case in point in Zimbabwe is Riozim, a subsidiary of RTZ plc. The company is rehabilitating an abandoned nickel mine in the middle of the country and is also involved in dump revegetation at Patchway gold mine and at other mines.

116. The Government should adopt an effective approach for ensuring environmental compliance. This would include offering incentives, economic or otherwise, that would offset the perceived high costs associated with installing technology that is more friendly to the environment. Serious efforts need to be made to mix economic and non-economic incentives in order to make mining companies more accountable for their activities.

117. Common methods used to entice mining companies to monitor their mining environment include the issue of environmental bonds and inclusion of environmental cleanup costs in project proposals before a mining property is developed. The use of economic instruments to control corporate environmental damage has become more common in recent years. The economic instruments are either price-based or quantity-based. Price based instruments include a variety of pollution taxes, such as emission charges, product charges, and deposit-refund systems. Tradable pollution rights and/or marketable permits are the most common quantity-based instruments. A variation of such instruments could be used.

118. For example, in the United States under the federal Surface Mining Control and Reclamation Act (SACRA), mining companies are required to post bonds before permits for mining operations are issued to the operator. The release of that bond is contingent upon the completion of all required reclamation, restoration, and abatement work on the permit area. However, the performance of the bond depends on the operator's faithfulness. Bond release requirements are in three phases; after successful completion of each phase part of the bond is released. In this system, phase one requires the following to be done: backfilling, regrading, top soil replacement, and drainage control after which 60 per cent of the bond is released. Phase two requires replacement of top soil, revegetation, curtailment of suspended solids and restoration of prime farmland, upon which about 25 per cent of the bond is released. The remaining 15 per cent of the environmental bond is released when reclamation has been achieved to the satisfaction of the federal authorities. Although such a system implies some subjectivity in assessing what is complete compliance, it does ensure that something is done to rehabilitate mined-out areas. It is interesting to note that this very idea has been mooted by an industry executive in Zimbabwe as a way of ensuring accountability and covering the costs of cleaning up.

119. The mining industry needs to be actively involved in whatever measures are designed, inasmuch as the decision on whether or not to go ahead with a project depends on the individual firm.

120. Another part of sound environmental management is known as Environmental Auditing. In this case, a firm's track record is 'audited' before it is allowed to go ahead with a mining project. This could be inserted into the Mines and Minerals Act since auditing in the form of an assessment of the technical and financial competence of a firm is carried out before a mining lease is granted. The same could be done for environmental management. The inherent danger is discrimination against those companies which may have 'dirty pasts' but have reformed. A way around this problem could be to link the audit to an

EIA. Fortunately, owing to stringent regulations in their home countries, most major mining companies have to varying degrees, gone 'green'. Convincing them of the need for sound environmental management should not be a problem.

121. From an administrative point of view, the trade-offs between costs of administering the regulations and the benefits from sound environmental management, and between economic growth and environmental protection, need to be thoroughly assessed before a set of guidelines is drawn up. For this reason, it is important for mining companies and the local community to participate in the legislative process concerning new environmental laws and regulations that may have a significant impact on operations and their standard of living.

122. There should be a provision in the mining lease agreement for reclamation of mining sites and for the restoration of land. To ensure compliance, a bond for the estimated cost of restoration could be posted at the beginning of mine development. At the end of the life of the mine, it would be redeemed if the land is restored to the satisfaction of the regulatory bodies; otherwise it would be used to effect further remedial measures. This type of legislation has been used quite successfully in Malaysia since the 1960s. Beyond just carrying out EIAs, companies should also be required to prepare plans for offsetting the negative impact of their activities such as dust and stack emissions.

123. Cyanide has been identified as the most common pollutant of both surface water and groundwater in formal gold mining. It should be made mandatory to treat the effluent appropriately. Some mines use ferrous sulphate to treat the solution and the resultant compounds decompose into non-toxic forms, one of which is a sulphate fertilizer, not unlike gypsum. Monitoring of cyanide use in small-scale operations is important, as dilution is often not done in the correct proportions, resulting in toxic ferrocyanide.

124. Standards should be set for stack emissions, especially from roasting plants. As legislation currently stands, penalties (which may include shut-downs) are imposed only if complaints are lodged with the Ministry of Health which, together with the Government's Department of Metallurgy, then assesses them. A more satisfactory solution would be to make sure these standards are applied and constantly monitored, with penalties imposed for excessive breaches.

125. To overcome the manpower and resource constraints, the existing institutions in the Department of Natural Resources that are concerned with environmental management should be strengthened and given more powers. Extensive educational programmes to ensure that the technical expertise is available should be undertaken not only within Zimbabwe but on a regional scale. Collaboration between countries within SADC in environmental matters should be undertaken to facilitate exchanges of ideas and experiences and could result in regional environmental regulations.

Notes

1. Small Scale Miners Association estimate.

2. Throughout the text, "tons" refer to metric tons.

3. 6.5 ZWD = 1 USD

4. 90 to 95 per cent are full-time panners.

5. Interview with Mr J.S. Swart of Patchway Mine and observations at the Patchway mine dump.

6. Low levels of mercury contamination have been detected in samples collected from the Umtshabezi River.

7. Development Dialogue, January 1994.

8. Currently Zimbabwe's largest gold producer, at 2.2 tons per year.

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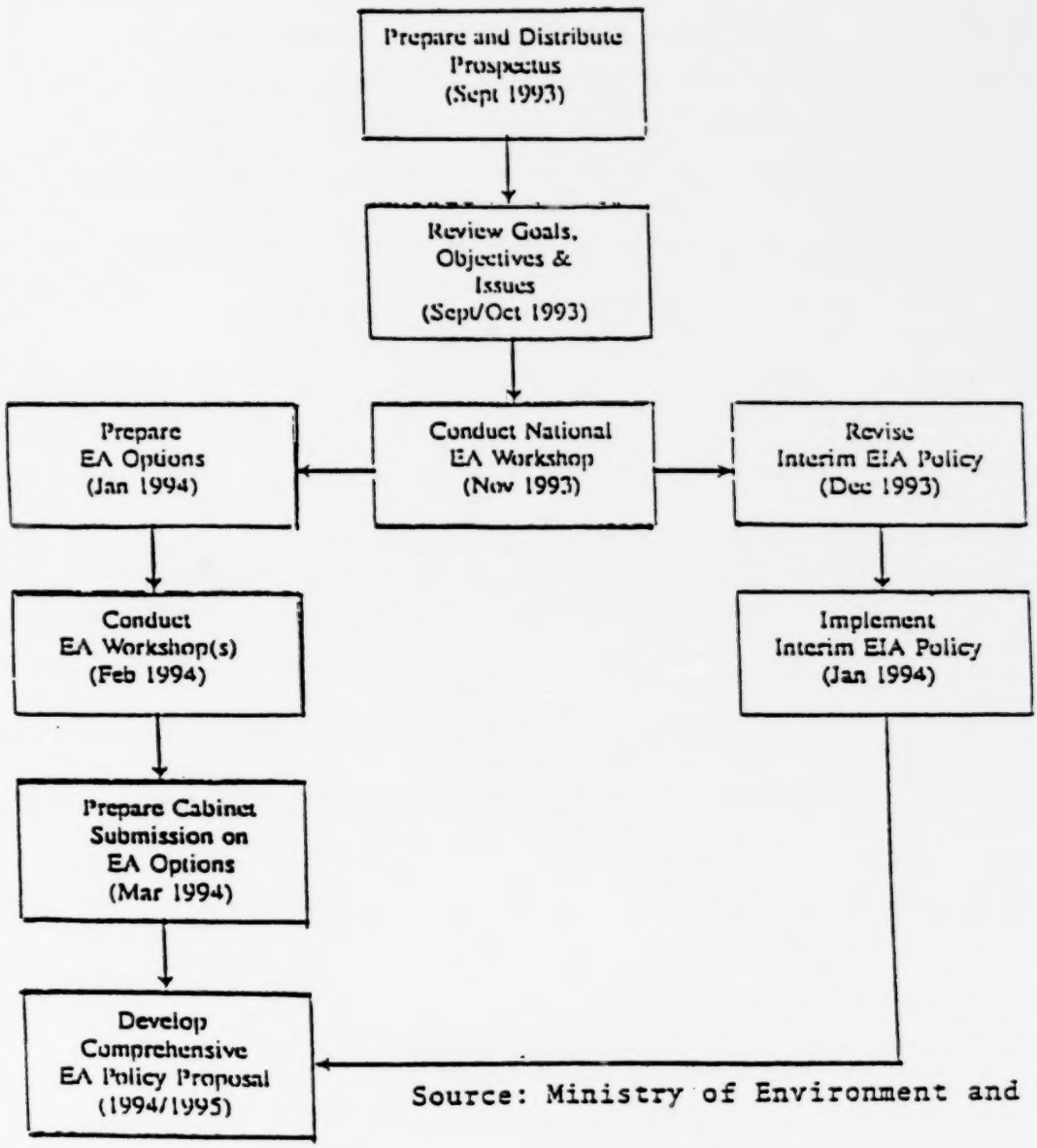
Dr. Mandal, Deputy Chief Government Mining Engineer
Mutasa, A., Regional Mining Engineer, Harare
Laurence, D., Principal Mining Engineer, Harare

APPENDICES

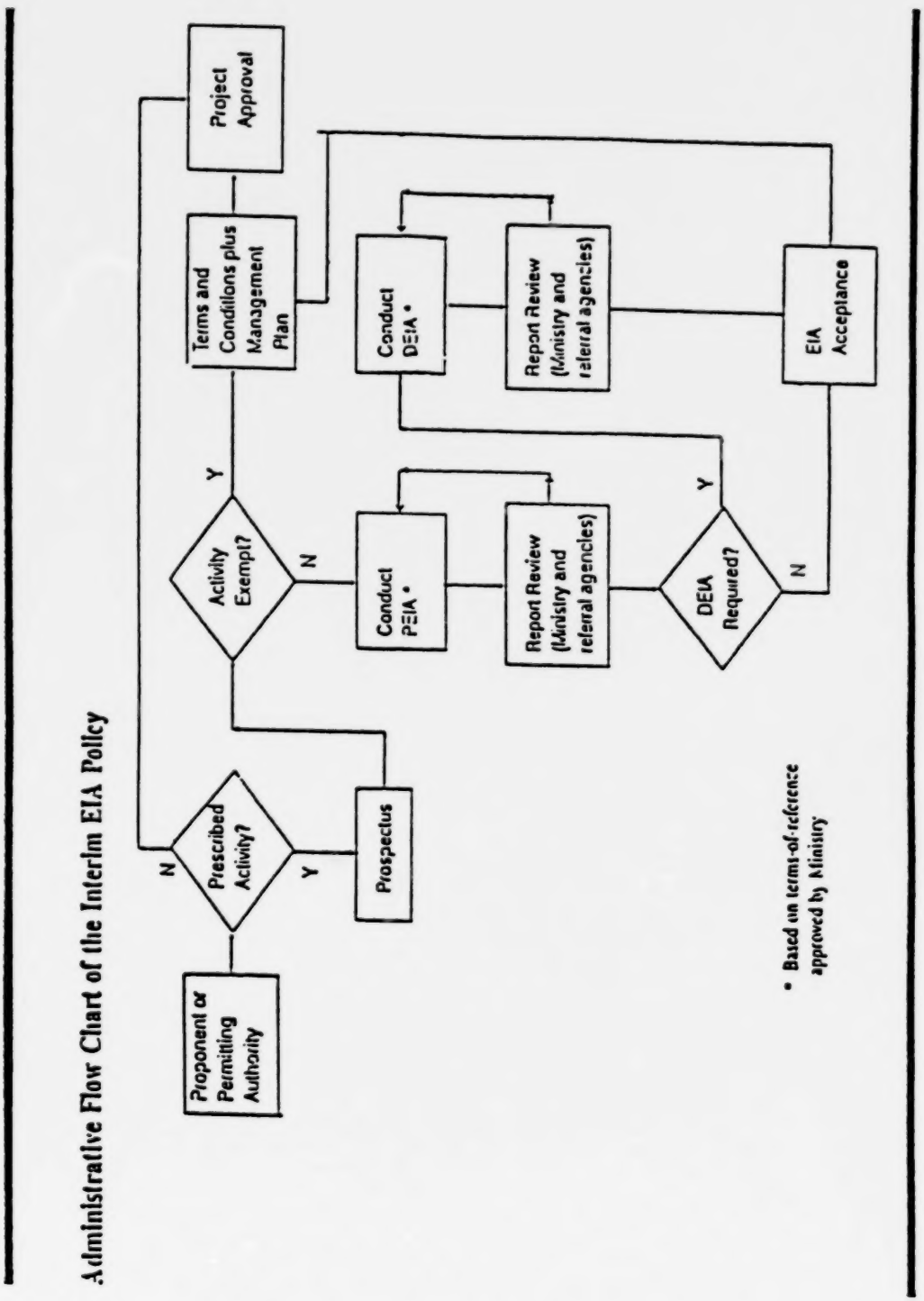
Appendix I

EA Programme Development Process


Prepare and Distribute Prospectus (Sept 1993)
Review Goals, Objectives & Issues (Sept/Oct 1993)
Conduct National EA Workshop (Nov 1993)
Prepare EA Options (Jan 1994)
Revise Interim EIA Policy (Dec 1993)
Conduct EA Workshop(s) (Feb 1994)
Implement Interim EIA Policy (Jan 1994)
Prepare Cabinet Submission on EA Options (Mar 1994)
Develop Comprehensive EA Policy Proposal (1994/1995)

Source: Ministry of Environment and Tourism

Appendix II



Source: Ministry of Environment and Tourism